HAIBRAIN XM10 OEM Controller

*O.E.M Original Equipment Manufacturer

Safety Warnings

- The wiring of your electrical installation is live (230 V) and extremely dangerous. Never connect the module when plugged into the mains. Always turn off the main switch before starting the installation.
- To prevent short circuits, this product should only be used inside and only in dry spaces. Do not expose the components to rain or moisture. Do not use the product close to a bath, swimming pool etc.
- Do not expose the components of your systems to extremely high temperatures or bright light sources.
- Do not open the product: the device contains live parts. The product should only be repaired or serviced by a qualified repairman
- In case of improper usage or if you have opened, altered and repaired the product yourself, all guarantees expire. Haibrain does not accept responsibility in the case of improper usage of the product or when the product is used for purposes other than specified. Haibrain does not accept responsibility for additional damage other than covered by the legal product responsibility.

How to implement

Two - way PLC interface for OEM applications (XM10)

The XM10 is a transmitter-receiver that plugs into a regular AC outlet and connects to the controller via a modular RJ 11 telephone jack. Alternatively, the XM10 may be fitted inside the controller cabinet, connected to the 230 V AC supply before the power transformer. (This would be a typical installation with most security panels.)
It provides an opto-coupled 50 Hz. Square wave, synchronised to the zero crossing point of the AC line. The controller generates X-10 compatible codes synchronised to this zero crossing point. The two-way interface then couples the X-10 codes onto the AC line.

Two - Way transmission available

The two-way interface transmits and receives X-10 codes. It enables an O.E.M. to develop a system to control X-10 Modules, and receive X-10 signals from remote sensors (P.I.R. motion detectors for example)

X-10 Code transmission

To transmit X-10 signals the controller must supply 1 ms .envelopes. to the TX input of the interface with respect to common. These envelopes must be as close as possible to the zero crossing point of the AC line (see timing diagrams). An opto- coupled output representing the zero crossing point of the power line is provided for the controller to which X-10 codes are to be synchronised.

X-10 Code reception

The two-way interface uses a custom proprietary I.C. to read X-10 codes from the power line. This takes a lot of burden off the microprocessor in the controller as it does not have to continuously monitor the powerline and check all in coming signals (and noise) for validity. Any signals applied to the controller are error-checked, valid X-10 codes. When a valid X-10 code is received, it is stored in the custom I.C. and

applied (in envelope form) to the controller. This output is coincident with the second X-10 transmission. (X-10 codes are always transmitted in groups of two, except for Bright and Dim.)
Data sent to the controller is valid X-10 data. The start Code (1110) can be used to alert the controller that an X-10 Code will follow. A .1. bit from the two-way interface appears as a negative going pulse 1.1 ms long, beginning approximately 100 µs after zero crossing. The controller should sample this data between 500 and 700 µs after zero crossing.
The L.E.D. on the two-way interface gives a visual indication that X-10 codes are being received. The L.E.D. is illuminated when AC power is applied to the two-way interface and blinks off when X-10 codes are received. The two-way interface will also receive the codes it transmits, therefore the L.E.D. will also give an indication of codes being transmitted.

The ability to read X-10 codes from its own output also allows the controller to incorporate data collision detection. If the code received differs from the code transmitted, the code can be assumed to have been corrupted by noise (or another transmission) on the power line.

The line Monitor capability of the two-way interface allows the controller to ensure that the power line is free from X-10 signals before starting a transmission. This means that in a multitransmitter system the controller can minimise contention between transmitters. For example, if after detecting that the line is free, a transmitter waits for a random number of power line half cycles before transmitting, the chance of collision is reduced. A different priority can be assigned to each transmitter by including a fixed delay before the random delay. The shorter the fixed delay, the higher the priority.

Important Safety Notice

Zero volts in this product is directly connected to one side of the AC line. Therefore, for safety, an ISOLATING power transformer MUST be used when attempting any internal measurements.

The power supply in the two-way interface are capacitively derived from, and directly referenced to, the 230V AC power line. Care should be taken when monitoring any internal circuitry with an oscilloscope, **as the OV reference in the two-way interface are NOT isolated from 230 volts.**

X-10 Protocol

The tables in Figure 1, show the Binary Codes to be transmitted for each House. Code and Key Code. The Start Code is Always 1110 which is a unique code and is the only code which does not follow the truecomplement relationship on alternate half cycles.

Figure 1
House Code and Key Code Tables

House Code						Key Codes					
	H_8	H_4	H_2	H_1		D_8	D_4	D_2	D_1	D_{16}	
A	0	1	1	0	1	0	1	1	0	0	
B	1	1	1	0	2	1	1	1	0	0	
C	0	0	1	0	3	0	0	1	0	0	
D	1	0	1	0	4	1	0	1	0	0	
E	0	0	0	1	5	0	0	0	1	0	
F	1	0	0	1	6	1	0	0	1	0	
G	0	1	0	1	7	0	1	0	1	0	
H	1	1	0	1	8	1	1	0	1	0	
I	0	1	1	1	9	0	1	1	1	0	
J	1	1	1	1	10	1	1	1	1	0	
K	0	0	1	1	11	0	0	1	1	0	
L	1	0	1	1	12	1	0	1	1	0	
M	0	0	0	0	13	0	0	0	0	0	
N	1	0	0	0	14	1	0	0	0	0	
O	0	1	0	0	15	0	1	0	0	0	
P	1	1	0	0	16	1	1	0	0	0	
All units off						0	0	0	0	1	
All lights on						0	0	0	1	1	
On						0	0	1	0	1	(shutters open)
Off						0	0	1	1	1	(shutters close)
Dim						0	1	0	0	1	(shutters up)
Bright						0	1	0	1	1	(shutters down)
All Lights Off						0	1	1	0	1	
Extended Code (1)						0	1	1	1	1	(for data/control)
Hail Request						1	0	0	0	1	
Hail Acknowledge						1	0	0	1	1	
Extended Code (3)						1	0	1	0	1	(for security messages)
Program						1	0	1	1	1	
Extended Code (2)						1	1	0	0	1	(for meter read & dsm)
Status = on						1	1	0	1	1	
Status = off						1	1	1	0	1	
Status Request						1	1	1	1	1	

(1) Hail Request is transmitted to see if there are any other X-10 transmitters within listening range. This allows the O.E.M to assign a different House code if a .Hail Acknowledge. is received.
(2) In a Pre-Set Dim instruction, the D8 bit represents the Most Significant Bit of the level and H1, H2, H4 and H8 bits represent the 4 Least Significant Bits.
(3) The Extended Data code is followed by 8 bit bytes which can represent Analog data (after A to D conversion). There should be no gaps between the Extended Data code and the actual data, and no gaps between data bytes. The first 8 bit byte can be used to say how many bytes of data will follow. If gaps are left between data bytes, these codes could be received by X-10 Modules causing erroneous operation.
Extended Code is similar to Extended Data: 8 Bit bytes which follow Extended Code (**with no gaps**) can represent additional codes. This allows the designer to expand beyond the 256 codes presently available.

Extended message format

Start Code	HC / inv HC	Ext / inv Ext	DC / inv DC	Data / inv Data	Command / inv Command	Command / inv Command
	House Code	Extended code	Unit code		Type/Type.	Func./Func
2 bits	4 bits	5 bits	4 bits	8 bits	4 bits	4 bits
1 1 0 0	H_1 H_2 H_4 H_8	**0 1 1 1 1**	D_1 D_2 D_4 D_8	D_{128} ... ...D_2 D_1		

The command field is split into two nibbles: Type and Function.
Each message is sent twice without a gap.

Example of Extended Data for light sensor:

Light sensor will respond to messages with the previous serial format and the response will be in the same format.

Request for light data for the module addressed in the House Code and Unit Code fields:

Start Code	HC / inv HC	Ext / inv Ext	DC / inv DC	Data / inv Data	Command / inv Command	Command / inv Command
	House Code	Extended code	Unit code		Type/Type.	Func./Func
2 bits	4 bits	5 bits	4 bits	8 bits	4 bits	4 bits
1 1 0 0	H_1 H_2 H_4 H_8	**0 1 1 1 1**	D_1 D_2 D_4 D_8	D_{128} ... ...D_2 D_1	**0 0 0 1**	**0 0 0 1**

The corresponding response will be Ambient Light Data from the module addressed in the House Code and Unit Code fields:

Start Code	HC / inv HC	Ext / inv Ext	DC / inv DC	Data / inv Data	Command / inv Command	Command / inv Command
	House Code	Extended code	Unit code		Type/Type.	Func./Func
2 bits	4 bits	5 bits	4 bits	8 bits	4 bits	4 bits
1 1 0 0	H_1 H_2 H_4 H_8	**0 1 1 1 1**	D_1 D_2 D_4 D_8	D_{128} ... ...D_2 D_1	**0 0 0 1**	**1 1 1 1**

The ambient light data is encoded in the data field in the following manner:

D_{128}	D_{64}	D_{32} D_{16}	D_8 D_4	D_2 D_1	Command / inv Command	Command / inv Command
0	0	Light Level	Range 0-630	steps of 10	(0-315	Lux steps of 5)
0	1	Light Level	Range 0-6 300	steps of 100	(0-3 150	Lux steps of 50)
1	0	Light Level	Range 0-63 000	steps of 1 000	(0-31 500	Lux steps of 500)
1	1	Light Level	Range 0-630 000	steps of 10 000	(0-315 000	Lux steps of 5 000)

Important notes

NOTE 1:
X-10 Receiver Modules require a .silence. of a least 3 power line cycles between each pair of 11 bit code transmissions (no gaps between each pair). The one exception to this rule is **bright and dim** codes. These are transmitted **continuously** with no gaps between each 11 bit dim code or 11 bit bright code. A 3 cycle gap is necessary between different codes. i.e. between bright and dim, or on and dim, or on and bright etc..

NOTE 2:
The .two-way. Power Line Interface can receive Extended Code or Extended Data.

NOTE 3:
The two-way interface can receive dim and bright codes but the output will represent the first dim or bright codes like the codes which were transmitted.

Transmission Timing Diagrams

A square wave representing zero crossing detect is provided by the two-way interface and is within 100 µs of the zero crossing point of the AC power line. The output signal envelope from the controller, should be within 50 µ of the zero crossing detect. The signal envelope should be 1 ms (-50 µs + 100 µs). See Figure 2.

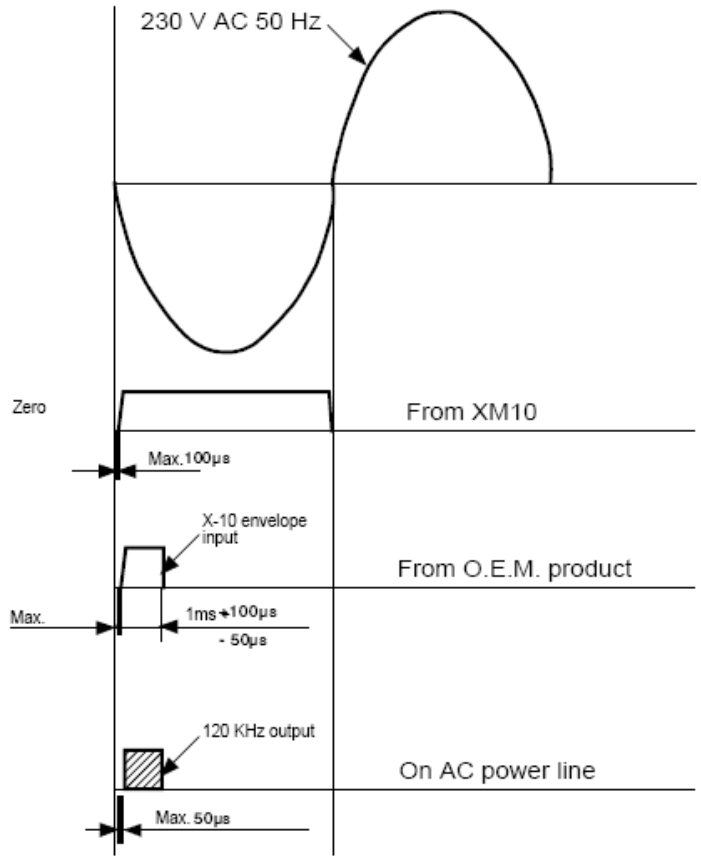


Figure 2: Transmit Timing Diagrams

Opto-Coupled 50 Hz reference output

Transmissions are to be synchronised to the zero crossing point of the AC power line and should be as close to true zero crossing as possible. The two-way interface are designed to be interfaced to other microprocessor circuitry which outputs X-10 codes synchronised to the zero crossing point of the AC power line. It is therefore necessary to provide a zero crossing reference for the controller microprocessor.

It is likely that this microprocessor will have its own .isolated. power supply. It is necessary to maintain this isolation, therefore the trigger circuit normally used in X-10 controllers is **not** desirable as this would reference the controller power supply to the AC power line. It is also **not** desirable to take the trigger from the secondary side of the power supply transformer as some phase shift is likely to occur. It is therefore necessary to provide an opto-coupled 50 Hz reference.

An opto-coupled 50 Hz square wave is provided at the output of the two-way interface. X-10 codes generated by the controller are to be synchronised to this zero crossing reference. The X-10 code envelope generate by the controller is applied to the two-way interface which modulates the envelope with 120 kHz, and capacitively couples it to the AC power line.

Opto-Couple Signal Imput

The input signal required from the O.E.M product is the signal .envelope. of the X-10 code format, i.e.

High for 1 ms. coincident with zero crossing represents a binary .1. and gates the 120 kHz, oscillator through to the output drive circuit thus transmitting 120 kHz, onto the AC power line for 1ms.

Low for 1 ms. coincident with the zero crossing point represents a binary .0. and turns the 120 kHz oscillator/output circuit off for the duration of the 1 ms input.

Opto-Coupled Signal Output

The .X-10 received. output from the two-way interface coincides with the second half of each X-10 transmission.
This output is the envelope of the bursts of 120 kHz received. Only the envelope corresponding to the first burst of each group of 3 bursts is available at the output of the two-way interface. See Figures 3, 4 and 5.

Start Code	House Code	Function Code	Start Code	House Code	Function Code
			Start Code	House Code	Function Code

Figure 3: X-10 code received from the AC power line

Received Timing Diagrams

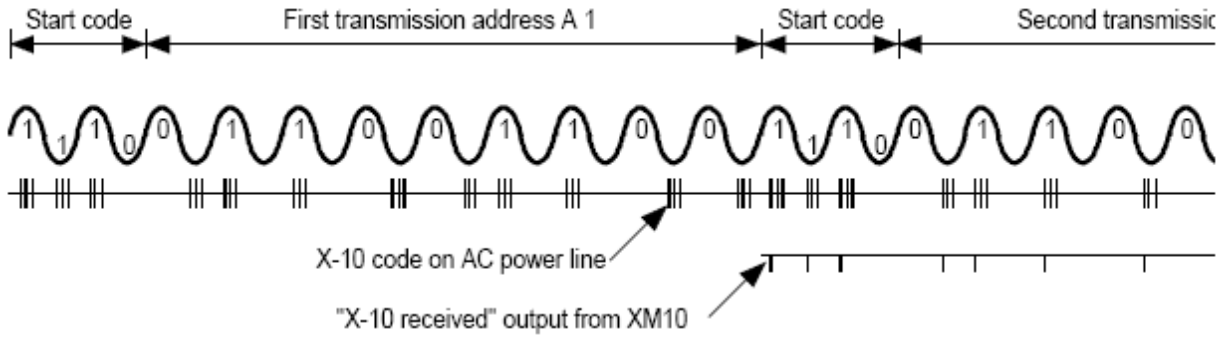

Start code
First transmission address A 1
Start code
Second transmissic
1 1 1 0 0 1 1 0 0 1 1 0 0 1 1 1 0 0 1 1 0 0
X-10 code on AC power line
"X-10 received" output from XM10

Figure 4

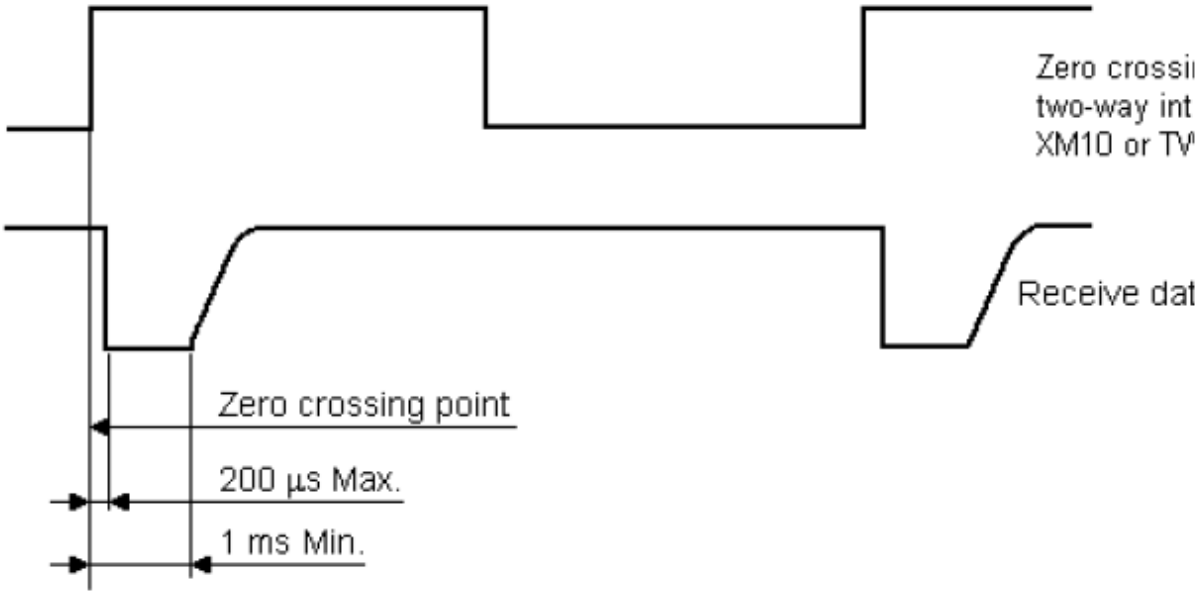
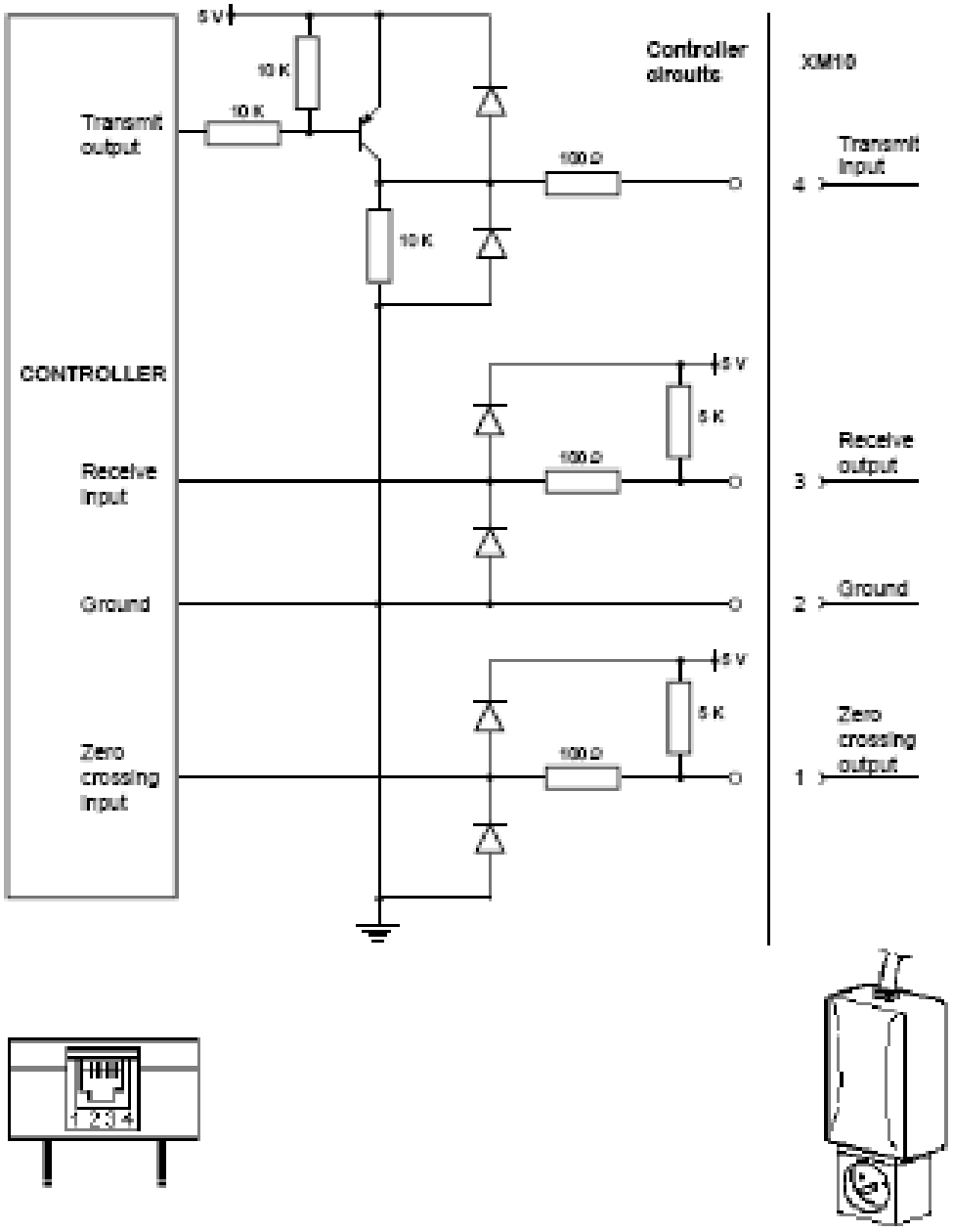


figure 5

Typical Controller Connection Diagram



Connection between the controller is via a standard modular phone jack, the connections for which are as follows:

1. B Zero crossing detect output (with respect to 2).
2. R Common.
3. G X-10 received envelope output (with respect to 2).
4. Y X-10 transmit envelope input (with respect to 2).

Technical data	
Supply voltage:	230V +10% -15% 50 Hz
Ambient temperature:	- 10° C to + 40° C (operation) - 20° C to + 70° C (storage)
DC characteristics:	
Serial data input:	
Min. logic «1»:	4 V input will sink approx 2,5 mA
Max. logic «1»:	20 V input will sink approx 18 mA
Max. logic «0»:	0.8 V will sink approx 0,1 mA (Voltages and currents with respect to terminal 2) Note: this output is an open collector transistor. Therefore, the logic «1» voltage is quoted as a reference for defining the output leakage current. An output pullup resistor is required to generate a logic level. The pullup can be returned to any voltage up to 20 V with respect to terminal 2.
AC characteristics:	
HF output to AC power line:	60 mW average into 5W
Conforms to Class 116 of EN50065-1:	load (2,5 V pk-pk instant.)
Carrier frequency:	120 kHz ± 2 kHz
Max. phase delay betwen 0 crossing point of AC power line and 0 crossing detect output (either transition):	100 msec
Max. allowable delay between transitions on 0 crossing detect output and serial data input «0» - «1» transition:	50 msec
Max. delay betwen serial input envelope «0» - «1» transition and carrier burst reaching 90 %:	50 msec
Width of X10 enveloppe :	1 ms +100 msec -50msec
Isolation voltage :	4 kV rms 50Hz for 1 min.

Environmental Information for Customers in the European Union
European Directive 2002/96/EC requires that the equipment bearing this symbol on the product and/or its packaging must not be disposed of with unsorted municipal waste. The symbol indicates that this product should be disposed of separately from regular household waste streams. It is your responsibility to dispose of this and other electric and electronic equipment via designated collection facilities appointed by the government or local authorities. Correct disposal and recycling will help prevent potential negative consequences to the environment and human health.
For more detailed information about the disposal of your old equipment, please contact your local authorities, waste disposal service, or the shop where you purchased the product.

DECLARATION OF CONFORMITY

Hereby, Haibrain BV, declares that this XM10 is in compliance with the essential requirements and other relevant provisions of the following Directives:

Council Directive 89/336/EEC of 3 May 1989 on the approximation of the laws of the Member States relating to electromagnetic compatibility

Council Directive 73/23/EEC of 19 February 1973 on the harmonization of the laws of Member States relating to electrical equipment designed for use within certain voltage limits

Hiermit erklärt Haibrain BV die Übereinstimmung des Gerätes XM10 den grundlegenden Anforderungen und den anderen relevanten Festlegungen der Richtliniën:

Richtlinie 89/336/EWG des Rates vom 3. Mai 1989 zur Angleichung der Rechtsvorschriften der Mitgliedstaaten über die elektromagnetische Verträglichkeit

Richtlinie 73/23/EWG des Rates vom 19. Februar 1973 zur Angleichung der Rechtsvorschriften der Mitgliedstaaten betreffend elektrische Betriebsmittel zur Verwendung innerhalb bestimmter Spannungsgrenzen

Par la présente Haibrain BV déclare que l'appareil XM10 est conforme aux exigences essentielles et aux autres dispositions pertinentes de la directives:

Directive 89/336/CEE du Conseil du 3 mai 1989 concernant le rapprochement des législations des États membres relatives à la compatibilité électromagnétique

Directive 73/23/CEE du Conseil, du 19 février 1973, concernant le rapprochement des législations des États membres relatives au matériel électrique destiné à être employé dans certaines limites de tension

Haibrain BV declara que este XM10 cumple con las exigencias esenciales y con las demás reglas relevantes de la directriz:

Directiva 89/336/CEE del Consejo de 3 de mayo de 1989 sobre la aproximación de las legislaciones de los Estados Miembros relativas a la compatibilidad electromagnética

Directiva 73/23/CEE del Consejo, de 19 de febrero de 1973, relativa a la aproximación de las legislaciones de los Estados Miembros sobre el material eléctrico destinado a utilizarse con determinados límites de tensión

Con ciò, Haibrain BV, dichiara che il XM10 è conforme ai requisiti essenziali ed altre disposizioni relative alla Direttiva :

Direttiva 89/336/CEE del Consiglio del 3 maggio 1989 per il ravvicinamento delle legislazioni degli Stati Membri relative alla compatibilità elettromagnetica

Direttiva 73/23/CEE del Consiglio, del 19 febbraio 1973, concernente il ravvicinamento delle legislazioni degli Stati Membri relative al materiale elettrico destinato ad essere adoperato entro taluni limiti di tensione

Bij deze verklaart Haibrain BV, dat deze XM10 voldoet aan de essentiële eisen en aan de overige relevante bepalingen van Richtlijnen:

Richtlijn 89/336/EEG van de Raad van 3 mei 1989 betreffende de onderlinge aanpassing van de wetgevingen van de Lid-Staten inzake elektromagnetische compatibiliteit

Richtlijn 73/23/EEG van de Raad van 19 februari 1973 betreffende de onderlinge aanpassing van de wettelijke voorschriften der Lid-Staten inzake elektrisch materiaal bestemd voor gebruik binnen bepaalde spanningsgrenzen

HAIBRAIN BV - P.O. BOX 9301 - 3506 GH UTRECHT THE NETHERLANDS

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